M 76/984

Preprint from the 1984

BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Montana

NEWARK PUBLIC LIBRARY

APR 15 1986

U. S. GOVT. PUBS.
DEPOSITORY 370

UNITED STATES DEPARTMENT OF THE INTERIOR

I 28.37/a 2:

READEX MICRO best copy available

UNITED STATES DEPARTMENT OF THE INTERIOR • Donald Paul Hodel, Secretary

BUREAU OF MINES • Robert C. Horton, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

The Mineral Industry of Montana

This chapter has been prepared under a Memorandum of Understanding between the Bureau of Mines, U.S. Department of the Interior, and the Montana Bureau of Mines and Geology for collecting information on all nonfuel minerals.

By W. L. Rice,[1] Henry G. McClernan,[2] and D. C. Lawson[3]

Montana's nonfuel mineral production value dropped in 1984 to $249 million, a 15% decrease from the $292 million recorded in 1983. An increase in gold production, a stability in the amount of silver produced, and an increase in industrial mineral production value were insufficient to offset depressed precious and base metals prices, a cessation of molybdenum production, and a substantial reduction in the production of copper.

Gold was the leading commodity in terms of value, followed by silver, copper, and portland cement. The metals—copper, gold, iron, lead, and silver—accounted for 58% of the total nonfuel mineral value for the year, compared with 64% of the total value in 1982, and 65% in 1983.

Table 1.—Nonfuel mineral production in Montana[1]

Mineral		1983		1984	
		Quantity	Value (thousands)	Quantity	Value (thousands)
Antimony	short tons	253	W	--	--
Barite	thousand short tons	10	$750	W	W
Clays	do.	194	6,205	397	$15,260
Copper (recoverable content of ores, etc.)	metric tons	33,537	56,245	W	W
Gem stones		NA	300	NA	450
Gold (recoverable content of ores, etc.)	troy ounces	161,436	68,449	181,190	65,348
Lead (recoverable content of ores, etc.)	metric tons	1,163	556	W	W
Lime	thousand short tons	86	W	89	5,097
Sand and gravel (construction)	do.	e5,000	e10,200	7,776	21,269
Silver (recoverable content of ores, etc.)	thousand troy ounces	5,708	65,299	5,653	46,018
Stone (crushed)	thousand short tons	872	r2,320	e950	e2,400
Combined value of cement, graphite, gypsum, iron ore, molybdenum (1983), peat, phosphate rock, sand and gravel (industrial), stone (dimension), talc, vermiculite, and values indicated by symbol W		XX	r81,644	XX	93,521
Total		XX	r291,968	XX	249,363

eEstimated. rRevised. NA Not available. W Withheld to avoid disclosing company proprietary data; value included with "Combined value" figure. XX Not applicable.

[1]Production as measured by mine shipments, sales, or marketable production (including consumption by producers).

Table 2.—Value of nonfuel mineral production in Montana, by county[1]

(Thousands)

County	1982	1983	Minerals produced in 1983 in order of value
Beaverhead	$427	W	Silver, stone (crushed), gold, lead, copper.
Big Horn	—	(2)	
Broadwater	490	W	Lime, gold, silver, graphite, lead, copper.
Carbon	W	W	Clays.
Carter	W	W	Do.
Cascade	1,714	W	Silver, stone (crushed), gold, lead, copper.
Custer	1	(2)	
Dawson	494	(2)	
Deer Lodge	209	W	Clays.
Fergus	W	W	Gypsum.
Flathead	2,970	(2)	
Gallatin	W	W	Cement, stone (crushed), clays.
Granite	9,580	W	Silver, gold, copper, lead.
Hill	W	(2)	
Jefferson	14,178	W	Gold, cement, stone (crushed), silver, lead, clays, copper.
Judith Basin	W	W	Gypsum.
Lake	W	$60	Peat.
Lewis and Clark	531	W	Gold, silver, copper, lead.
Liberty	W	(2)	
Lincoln	77,444	86,640	Silver, copper, vermiculite, lead, gold.
Madison	8,529	W	Talc, gold, silver, copper, lead.
Meagher	W	W	Iron ore, stone (crushed), gold.
Mineral	29	(2)	
Missoula	W	750	Barite.
Musselshell	45	(2)	
Park	W	185	Stone (dimension), stone (crushed), sand and gravel (industrial).
Petroleum	44	(2)	
Phillips	27,350	W	Gold, silver, copper, lead.
Pondera	22	(2)	
Powell	W	W	Phosphate rock, gold, silver, lead, copper.
Ravalli	W	W	Peat.
Richland	1,564	1,475	Lime.
Rosebud	W	(2)	
Sanders	W	W	Antimony.
Sheridan	62	(2)	
Silver Bow	W	W	Copper, molybdenum, silver, gold, lead.
Stillwater	(3)	—	
Toole	159	(2)	
Valley	W	W	Clays.
Wibaux	8	(2)	
Yellowstone	W	W	Lime.
Undistributed[4]	r120,187	192,660	
Sand and gravel (construction)	XX	e10,200	
Stone:			
Crushed	e4,700	XX	
Dimension	W	XX	
Total[5]	r270,731	291,968	

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; included with "Undistributed."
XX Not applicable.

[1]No production of nonfuel mineral commodities was reported for counties not listed.

[2]Construction sand and gravel was produced; data not available by county. Total State value is shown separately under "Sand and gravel (construction)."

[3]Crushed stone was produced; data not available by county. Total State value is shown separately under "Stone: Crushed."

[4]Includes gem stones and some stone production that cannot be assigned to specific counties and values indicated by symbol W.

[5]Data do not add to totals shown because of independent rounding.

Table 3.—Indicators of Montana business activity

		1982[r]	1983	1984[p]
Employment and labor force, annual average:				
Population	thousands	805	815	824
Total civilian labor force	do.	393	396	405
Unemployment	do.	34	35	30
Employment (nonagricultural):				
Mining total[1]	do.	9.3	7.4	7.5
Metal mining[2]	do.	1.7	1.5	NA
Nonmetallic minerals except fuels[2]	do.	.9	.9	NA
Coal mining[2]	do.	1.3	1.3	NA
Oil and gas extraction[2]	do.	5.5	3.7	NA
Manufacturing total	do.	20.6	22.1	22.3
Primary metal industries[2]	do.	1.4	1.2	NA
Stone, clay, and glass products[2]	do.	1.1	1.1	NA
Chemicals and allied products[2]	do.	.5	.5	NA
Petroleum and coal products[2]	do.	1.0	1.0	NA
Construction	do.	13.4	13.3	12.6
Transportation and public utilities	do.	22.0	20.4	20.5
Wholesale and retail trade	do.	71.9	73.6	76.4
Finance, insurance, real estate	do.	12.8	13.0	13.4
Services	do.	56.3	57.8	59.8
Government and government enterprises	do.	67.4	68.4	68.3
Total	do.	[r]273.7	276.0	[3]280.9
Personal income:				
Total	millions	$7,790	$8,196	$8,690
Per capita		$9,679	$10,050	$10,546
Hours and earnings:				
Total average weekly hours, production workers		39.3	39.7	39.1
Mining		41.9	41.3	39.4
Total average hourly earnings, production workers		$9.86	$10.44	$10.74
Mining		$12.54	$12.94	$12.80
Earnings by industry:				
Farm income	millions	$585	$151	$795
Nonfarm	do.	$36,515	$39,502	$43,722
Mining total	do.	$201	$187	$195
Metal mining	do.	$72	$66	$54
Nonmetallic minerals except fuels	do.	$53	$52	$61
Coal mining	do.	$63	$61	$72
Oil and gas extraction	do.	$13	$7	$8
Manufacturing total	do.	$9,199	$9,829	$11,136
Primary metal industries	do.	$388	$369	$422
Stone, clay, and glass products	do.	$248	$267	$293
Chemicals and allied products	do.	$851	$901	$983
Petroleum and coal products	do.	$45	W	W
Construction	do.	$1,899	$2,083	$2,476
Transportation and public utilities	do.	$3,845	$4,178	$4,454
Wholesale and retail trade	do.	$6,589	$6,830	$7,531
Finance, insurance, real estate	do.	$2,075	$2,398	$2,643
Services	do.	$7,144	$7,962	$8,833
Government and government enterprises	do.	$5,459	$5,922	$6,329
Construction activity:				
Number of private and public residential units authorized		2,052	3,057	2,654
Value of nonresidential construction	millions	$121.6	$130.0	$121.1
Value of State road contract awards	do.	$79.4	$144.5	$143.9
Shipments of portland and masonry cement to and within the State	thousand short tons	229	266	254
Nonfuel mineral production value:				
Total crude mineral value	millions	$270.7	$292.0	$249.4
Value per capita		$336	$358	$303

[p]Preliminary. [r]Revised. NA Not available. W Withheld to avoid disclosing company proprietary data.
[1]Bureau of Labor Statistics, U.S. Department of Labor; totals may not add because of inclusion of data from other sources.
[2]Bureau of Economic Analysis, Regional Economic Measurement Division, U.S. Department of Commerce.
[3]Data do not add to total shown because of independent rounding.

Sources: U.S. Department of Commerce, U.S. Department of Labor, Highway and Heavy Construction Magazine, and U.S. Bureau of Mines.

The impact of the June 1983 suspension of The Anaconda Minerals Co.'s Butte copper operations continued to be felt in 1984; the State's copper production suffered a significant drop, and no molybdenum was produced during the year. Anaconda Minerals sold a large part of the open pit mining equipment it used when the Berkeley Pit was in full production and was concluding a small-scale drilling program to refine its knowledge of the district. Hopes for an early resumption of mining, bolstered by favorable union work rule changes, faded by yearend as copper prices remained at a depressed level.

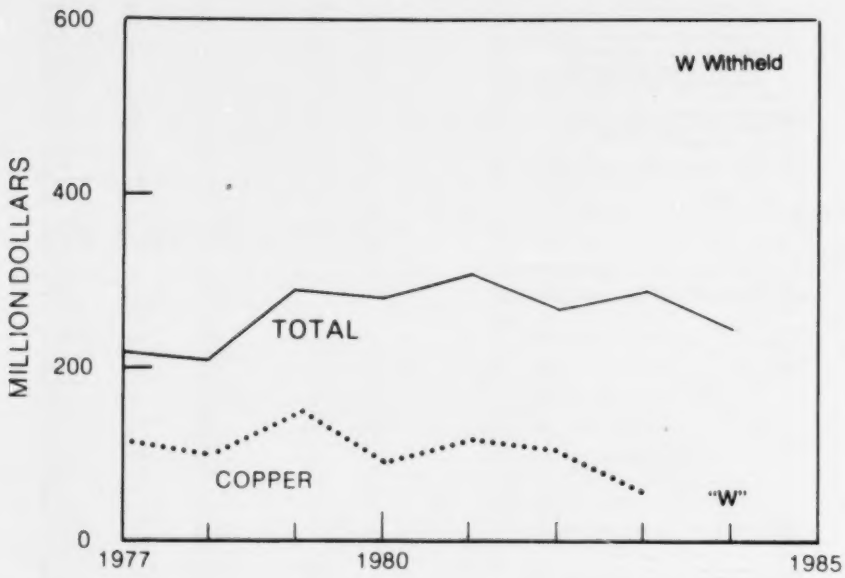

Figure 1.—Value of copper and total value of nonfuel mineral production in Montana.

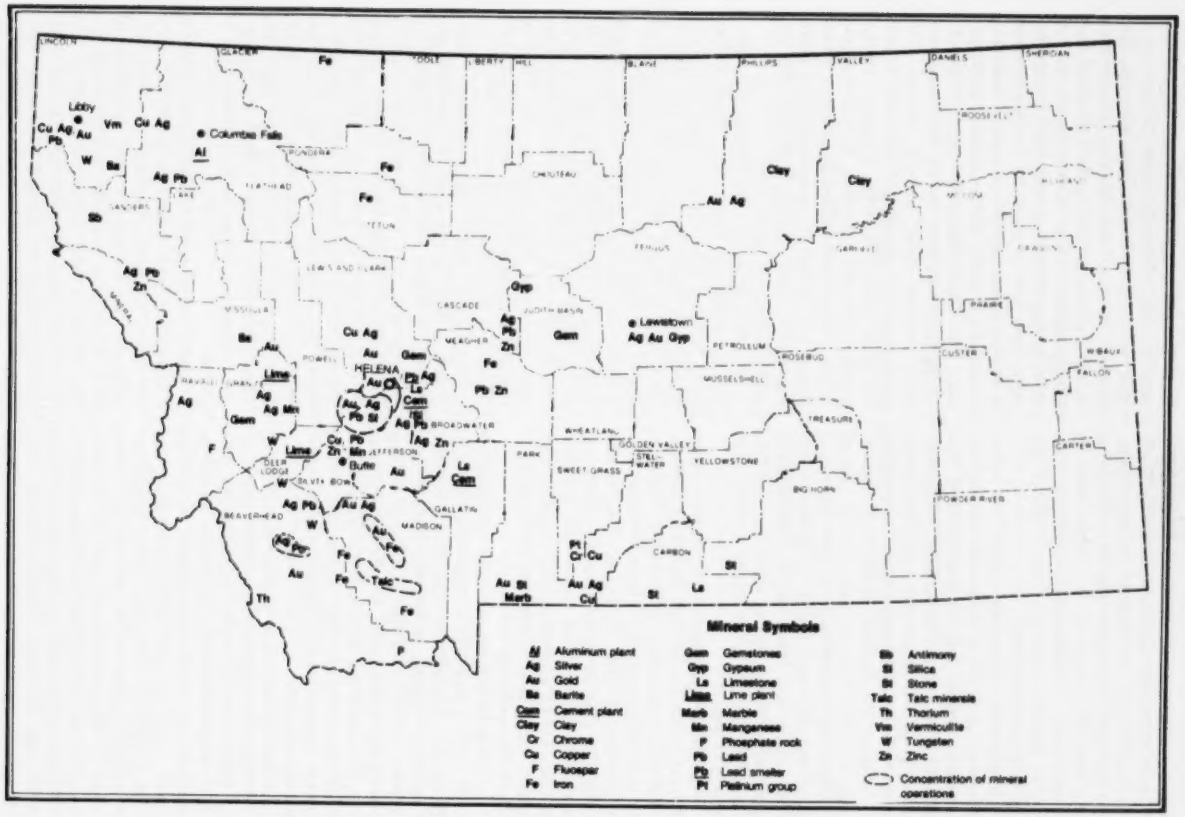

Figure 2.—Principal mineral producing localities in Montana.

Employment.—Overall mining employment in Montana for 1984 was 7,500, slightly more than the number reported for 1983. Average weekly earnings for mineral industry production workers was $419.93; it was the second highest in the State, next to wages paid to construction workers. This figure represented a decrease of $30.10 per week from that of 1983.

Exploration Activities.—The level of exploration activity in Montana, largely for precious metals, was up slightly from that of 1983. The number of exploration licenses granted by the Department of State Lands increased from 201 granted to 75 companies in 1983 to 215 licenses issued to 91 companies in 1984. The number of new mining claims filed in 1984 with the U.S. Bureau of Land Management (BLM) in Montana was down about 30% from that for 1983, and the number of small mine exclusion permits issued by the State decreased in 1984 from the 1983 level.

ASARCO Incorporated and United States Borax & Chemical Corp. continued exploration for stratabound silver-copper deposits in and adjoining the Cabinet Mountains Wilderness in Lincoln County. Asarco submitted a plan of operations to permitting agencies at midyear and did baseline studies for an environmental impact statement; U.S. Borax drilled on claims outside the wilderness area boundary.

Drilling to firm up reserves continued in 1984 on the Centennial Minerals Ltd.-U.S. Minerals Exploration Co. joint venture Montana Tunnels gold-silver project near Wickes, Jefferson County. An engineering feasibility study conducted during the year recommended the deposit be developed as a 15,000-short-ton-per-day open pit mine using conventional flotation-cyanide processing methods.

Aries Resources began work in August on a 2-year silver exploration project just west of Butte in Silver Bow County. The 1,705-acre area, owned by Anaconda Minerals, contains up to 30 mineralized veins that have values in gold, silver, zinc, lead, and manganese. Lee Mining Corp. completed drilling by midyear on an area north and west of Walkerville as part of a silver exploration project. Lee also conducted preliminary exploration at the Southern Cross Mine near Anaconda. Dragon Energy Corp. completed a percussion drilling program on its 54-claim group 12 miles southwest of Butte; the company reported that significant gold mineralization was indicated.

AMAX Exploration Inc. participated with Gulf Titanium Ltd. in an exploration project at the Cruse-Belmont Mines near Marysville, Lewis and Clark County. The Goldsil Mining and Milling Co.-Consolidated Paymaster Resources Ltd. joint venture completed three drill holes on the 400 level of the Drumlummon Mine at Marysville; one hole intersected 14 feet of vein with an 8-foot section assaying 0.44 troy ounce of gold and 1.0 troy ounce of silver per ton. Big Horn Minerals Corp. continued exploration drilling at its Scratchgravel gold prospect near Helena; several drill intercepts with significant gold assays were reported from relatively shallow depths. Property in and near Rimini in Lewis and Clark County was drilled by Century Silver Mines Inc.; 6 feet of massive sulfides bearing silver, lead, copper, and zinc was encountered in the second hole.

Cominco American Incorporated's exploration project in the Smith River Valley near White Sulphur Springs was continued during the year, and Cominco also drilled on the Gold Eagle Mining Co. Inc.'s High Tariff property in the Neihart district.

Beralynn Resources Inc. drilled several targets on its Goldstar gold property in the Silver Star district in Madison County. Gold occurrences on the Plymouth, Three Forks, and Klondyke properties in the Elkhorn district, Jefferson County, were explored by Mountain West Resources.

Legislation and Government Programs.—Work progressed on the Montana Bureau of Mines and Geology (MBMG)-U.S. Geological Survey (USGS) cooperative effort to produce Conterminous United States Mineral Appraisal Program (CUSMAP) 2° geologic maps for incorporation into Montana's Atlas Series. The Wallace sheet was well on the way to completion by yearend, and progress was made on the Kalispell, Hamilton, Butte, Dillon, Wolf Point, Jordan, Glendive, Forsyth, and Miles City 2° maps.

Major current MBMG projects include a compilation and review of Montana barite deposits, regional analysis of favorable geologic environments for stratabound and stratiform precious and base metals ore deposits, and a regional appraisal of economic mineral potential in the Belt 1:100,000-scale quadrangle in central Montana. The MBMG released 11 formal publications and placed 34 titles on open-file in 1984, and the ongoing MBMG-USGS hydrologic cooperative program worked on 7 proj-

ects during the year.

The Mining and Mineral Resources Research Institute of the Montana College of Mineral Science and Technology at Butte received an allotment from the U.S. Bureau of Mines in 1984.

Montana received $22.9 million in 1984 from the BLM as receipts from the Mineral Leasing Act.

Mineral taxes collected by the State on nonfuel minerals, coal, oil, and natural gas amounted to $148 million in fiscal year 1984; mineral taxes represented 27.6% of the total Montana Department of Revenue collections for the year.

Montana's congressional delegation introduced joint legislation in 1984 to add 747,178 acres of land to the State's wilderness areas. In addition, 507,232 acres was proposed for scenic, wildlife, or recreational use, and 5 million acres would be released for multiple purpose uses under U.S. Forest Service management. The proposed bill, which would have brought Montana's total wilderness area up to 4,107,639 acres, was not enacted by Congress.

REVIEW BY NONFUEL MINERAL COMMODITIES

METALS

Aluminum.—Primary aluminum production in Montana increased 65% in quantity and 88% in value over that of 1983. Reflecting the mid-1983 economic recovery, ARCO Aluminum Co.'s reduction plant at Columbia Falls, Flathead County, operated at the highest production level since 1981. Despite a worldwide aluminum oversupply, which led to a 68% drop in aluminum prices by midyear, and despite increased electric power rates, the Columbia Falls smelter finished the year operating at 100% of rated capacity.

Copper.—Copper production was reported from 6 mines and 1 leaching operation in 5 counties in 1984, compared with output from 19 mines in 11 counties in 1983. Montana's copper production ranked fourth in the Nation.

The State's three top-ranked producers were Asarco's Troy silver-copper mine in Lincoln County, Anaconda Minerals from leaching operations at Butte, and Black Pine Mining Co.'s Black Pine Mine near Philipsburg in Granite County. Montana's copper production was down significantly from that of 1983.

Gold.—Gold production was reported from 14 lode mines in 7 counties in 1984, compared with production from 24 mines in 10 counties in 1983. Two placer operations reported production, and gold was recovered from retreatment of old mine tailings. Montana's gold production ranked fourth in the Nation, accounting for nearly 9% of the national total in 1984. The State's 1984 gold production was up 12% in quantity from that of 1983, but value decreased by 5%.

Placer U.S. Inc. increased production at its Golden Sunlight Mine near Whitehall, Jefferson County. Production increased from nearly 80,000 troy ounces in 1983 to about 97,000 ounces in 1984, and mill throughput increased from 1.6 million short tons in 1983 to almost 1.9 million tons in 1984. Mine development at the Mineral Hill open pit continued throughout the year, and progress was made on studies to develop the mine's deep West Mineral Hill zone. The Golden Sunlight Mine was Montana's first-ranked gold producer in 1984, accounting for nearly 54% of the State's production.

Pegasus Gold Inc. (formerly Pegasus Gold Ltd.) continued to produce gold and silver from its Zortman and Landusky open pit mines and heap leach facility in the Little Rockies district in Phillips County. The operation, which is constrained to 7 or 8 months per year because of severe winter weather conditions, added 5.7 million tons of ore to the leach pads in 1984, bringing the total amount of ore placed on the pads to 17.9 million tons. The construction of large-scale leach pads was initiated in 1984, and a rigorous grade control program, which contributed to a lower waste-to-ore ratio, was implemented during the year. Exploration and development work and the acquisition of adjacent property increased ore reserves at the Zortman-Landusky operations from 22.7 to 43 million tons by yearend. The Pegasus operations ranked second in the State in gold production for 1984.

Pegasus Gold Inc. was formed as a new company by the merger in August of Pegasus Gold Ltd. and Montoro Gold Inc. The company completed approximately 10,000 feet of drilling to further delineate reserves at Montoro's Beal property at German Gulch, southwest of Butte in Silver Bow County.

The Homestake Mining Co.-American Copper & Nickel Co. Inc. (a subsidiary of Inco Ltd.) joint venture continued develop-

ment work on its Jardine gold mine north of Gardiner, Park County. The proposed 750-ton-per-day mine would have a 20-year mine life. Formal application for operating permits was made in August; if permits are granted, mine construction is projected to begin in the spring of 1986, followed by production in 1987.

The Golden Maple Mining and Leaching Co. operated its Gilt Edge open pit mine and leach plant near Lewistown in Fergus County; the first gold doré bar was poured in September from ore previously mined. The company planned to mine and commence leaching on 150,000 tons of ore in 1984. Pilot mining and leaching operations were carried out at the North Moccasin Mine by Canadian Minerals Inc.; the mine is about 15 miles northwest of Lewistown. Triad Investments Inc., operator of the Judith gold property at Kendall in Fergus County, did additional development drilling north and south of the Muleshoe Claims and commenced heap-leaching operations.

Lead.—Lead was recovered as a byproduct from six precious and base metals mines in four counties, and from reprocessing old tailings. Montana ranked fifth in the Nation for lead production in 1984; the State's lead production decreased 18% from the 1983 level.

Asarco's East Helena smelter, the only remaining lead smelter in the Northwestern United States, operated at capacity throughout the year. Feedstocks were predominantly purchased and custom toll concentrates from both domestic and foreign sources; bullion was shipped to Asarco's Omaha, NE, refinery. The zinc fuming plant placed on standby in 1982 did not operate in 1983 and 1984.

Platinum-Palladium.—Stillwater Mining Co., a joint venture between Manville Products Corp., Chevron Resources Inc., and Anaconda Minerals, completed a bulk sampling program and continued a feasibility study during 1984. The proposed 1,000-ton-per-day mine in the Stillwater Complex near Nye, Stillwater County, would produce about 350,000 to 360,000 troy ounces of palladium per year; the ratio of palladium to platinum in the ore would be about 3.1 to 1. A production decision is expected in 1986.

Silver.—Although the quantity of silver produced in Montana in 1984 was nearly the same as that credited for 1983, depressed silver prices caused a 30% drop in production value from the 1983 level. The State again produced nearly 13% of the Nation's silver in 1984; however, it dropped to third ranking in total silver production. In 1984, silver production was reported from 14 mines in 8 counties and from retreatment of old tailings, compared with production from 28 mines in 12 counties during 1983.

Asarco's Troy Mine in Lincoln County was again Montana's top silver producer, accounting for nearly 76% of the State total; the Troy Mine also was the third-ranked producer in the Nation for 1984. Black Pine Mining's Black Pine Mine in Granite County was the State's second largest silver producer; ore from the Black Pine Mine was beneficiated by Contact Mining Co. in its 1,200-ton-per-day mill at Philipsburg in Granite County. Contact Mining continued work on reopening the Granite-Bimetallic Mine in the Philipsburg district. Byproduct silver reported by Pegasus Gold Inc. from its Zortman-Landusky gold operation in Phillips County gave that company third ranking in 1984 silver production for the State.

CoCa Mines Inc. indefinitely deferred mine development and reopening of its silver deposits in the Hog Heaven district, Flathead County. The company had finished exploration on an open pit minable ore body and on a mineralized zone to be developed for underground mining. Mine development and reclamation plans had been approved by the State, a $350,000 reclamation bond had been posted, and construction was to have begun in the fall of 1984.

Asarco submitted a plan of operations to the U.S. Forest Service and to the State for its proposed Rock Creek silver-copper mine in the Cabinet Mountains Wilderness area, Sanders County. Ore reserves estimated at 143.7 million tons would be mined by room and pillar methods through double, 2-mile-long adits with portals over 1 mile outside the wilderness boundary. Ore would be transported by conveyor from an underground crusher to a surface mill complex. The mine would produce at a rate of 10,000 tons per day, with an estimated annual production of 5.3 million ounces of silver and 21,800 tons of copper; mine life was estimated at 29 years.

Table 4.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in 1984, by class of ore or other source material

Source	Number of mines[1]	Material sold or treated[2] (metric tons)	Gold (troy ounces)	Silver (troy ounces)	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)
Lode ore:							
Dry gold[3]	8	W	W	170,149	--	W	--
Gold-silver	3	1,138	374	W	W	W	--
Silver	4	W	W	W	W	W	
Total	15	W	W	W	W	W	--
Copper[3]	1	W	--	--	W	--	--
Other lode material:							
Gold tailings	1	W	W	W	--		--
Gold-silver tailings	1	W	W	W	--	W	--
Total lode	16	W	W	[4]5,652,847	W	W	--
Placer	2	--	W	--	--	--	--
Grand total	18	[4]10,034,174	[4]181,190	5,652,847	W	W	--

W Withheld to avoid disclosing company proprietary data.
[1]Details may not add to total because some mines produce more than one class of material. Operations from which metals were recovered only from tailings are not counted as producing mines.
[2]Does not include gravel washed.
[3]Includes material that was leached.
[4]Includes items indicated by symbol W.

Table 5.—Montana: Mine production (recoverable) of gold, silver, copper, lead, and zinc in Silver Bow County

Year	Mines producing	Material sold or treated (thousand metric tons)	Gold (troy ounces)	Silver (thousand troy ounces)
1980	1	8,244	11,541	1,596
1981	1	13,729	14,394	2,028
1982	1	12,847	3,361	739
1983	1	6,287	1,383	313
1984	3	W	W	W
1882-1984	--	W	W	W

Year	Copper (metric tons)	Lead (metric tons)	Zinc (metric tons)	Total value[1] (thousands)
1980	37,467	--	--	$124,602
1981	59,477	--	--	139,555
1982	48,144	--	--	84,410
1983	18,694	111	--	35,761
1984	W	W	W	W
1882-1984	W	W	W	W

W Withheld to avoid disclosing company proprietary data.
[1]Derived from average values of the metals; includes average value of copper produced in wire bars prior to 1982 and average value of copper produced in cathodes for 1982, 1983, and 1984.

NONMETALS

Barite.—Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures, operated barite mines at Elk Creek and Coloma in the Garnet Range and started mining at the Kenelty deposit east of Libby in Lincoln County. Barite was processed at the company's mill in Missoula.

Cement.—The amount of cement produced in Montana in 1984 increased about 3% over that of 1983, but the continued low level of construction activity precluded any significant change in production. Portland and masonry cements were produced by Kaiser Cement Corp. at Montana City in Jefferson County and by Ideal Basic Industries Inc. at Trident, Gallatin County. Portland cement produced in the State was used by ready-mixed concrete companies (67%); other contractors (20%); concrete products manufacturers (6%); and building material dealers, highway contractors, government agencies, and miscellaneous customers (7%). Raw materials consumed in cement manufacture were limestone, clays, sandstone, sand, iron ore, gypsum, slag, and other additives. Shipments to consumers

were mostly by truck and rail.

Clays.—Montana moved up to second ranking in bentonite production for 1984; production doubled in quantity and was nearly 2-1/2 times greater in value than that reported for 1983. Bentonite was produced by 4 companies from 16 deposits in Carbon, Carter, and Valley Counties.

American Colloid Co. processed previously mined and stockpiled bentonite at its plant in Malta. Aurora Industries Inc.'s Federal Bentonite Div. mined and field-dried bentonite from its Glasgow deposit; the partially dried material was shipped to Federal Bentonite Div.'s Burnett, MN, plant for further processing and sale to the taconite industry. In April, Aurora signed a letter of intent with IMCO Services of Dallas, TX, a Halliburton Co. subsidiary, to purchase Aurora's Federal Bentonite Div.

A large share of Montana's bentonite was sold for drilling mud, iron ore pellet binder, and foundry sand.

Common clay, produced by four companies from five pits in Gallatin and Jefferson Counties, was used in portland cement, concrete blocks, and in pottery.

Gem Stones.—Montana ranked fourth in the Nation in gem stone production in 1984. Intergem Inc. continued to mine commercial quantities of corundum gem stones, including blue sapphires, from its Yogo Gulch deposit in the Little Belt Mountains, Fergus County. Sapphire-bearing dike rock is surface mined, allowed to weather for 3 years, and processed by gravity methods to recover the sapphires.

Graphite.—Montana remained the Nation's only producing State for natural amorphous graphite in 1984. Production by National Minerals Corp. in Broadwater County decreased about 50% in quantity and value from that reported in 1983.

Gypsum.—Gypsum production in Montana increased nearly 19% in quantity and 16% in value over that reported for 1983. A limited recovery in building construction, with a resulting improvement in the wallboard industry, accounted for the increase.

United States Gypsum Co. mined gypsum from its underground Shoemaker Mine at Heath in Fergus County; the gypsum was used in the company's wallboard plant. Maronick Construction Co. Inc. reclaimed two open pit mines at Raynesford, Judith Basin County, and shipped gypsum to the Kaiser Cement plant at Montana City and to the Ideal Basic Industries cement plant at Trident.

Lime.—The quantity of lime produced in the State increased about 3% and the value nearly 16% over that recorded for 1983. Continental Lime Inc., Holly Sugar Corp. and The Great Western Sugar Co. produced lime in Broadwater, Richland, and Yellowstone Counties, respectively.

Phosphate Rock.—Phosphate rock production in the State increased 11% in quantity and 17% in value over that of 1983, owing to a continued partial recovery in the agricultural fertilizer market. Montana's only producer, Cominco, continued to mine phosphate at its underground Warm Springs Mine near Garrison in Powell County. Cominco can now ship phosphate on a year-round basis to its fertilizer plant at Kimberley, British Columbia, Canada, as a result of construction of a thawing facility for railroad hopper cars at that plant.

Stauffer Chemical Co. cited higher sales, reduced plant inventory, and generally improved economic conditions as reasons for restarting the second furnace at its Silver Bow elemental phosphorus plant near Butte. The plant processes phosphate ore from the company's Wooley Valley Mine in Idaho.

Sand and Gravel.—*Construction.*—Construction sand and gravel production is surveyed by the U.S. Bureau of Mines for even-numbered years only; therefore, this chapter contains only estimates for 1983. Data for odd-numbered years are based on annual company estimates made before yearend.

The 1984 output of construction sand and gravel in Montana increased nearly 46% in quantity and 66% in value, and the unit value was up 14% from that reported for 1982, when the last complete canvass was taken. The largest increases were in the asphaltic concrete and other uses categories.

In 1984, five counties—Flathead, Gallatin, Missoula, Silver Bow, and Yellowstone—accounted for 57% of the State's total construction sand and gravel production tonnage. Major uses were for road base and coverings (25%), asphaltic concrete (25%), concrete aggregate (7%), and other uses (36%); the bulk of Montana's construction sand and gravel (98%) was transported by truck.

Table 6.—Montana: Construction sand and gravel sold or used in 1984, by major use category

Use	Quantity (thousand short tons)	Value (thousands)	Value per ton[1]
Concrete aggregate	571	$2,183	$3.82
Plaster and gunite sands	W	W	2.30
Concrete products	W	W	4.44
Asphaltic concrete	1,936	6,517	3.37
Road base and coverings[2]	1,939	4,940	2.55
Fill	452	803	1.77
Snow and ice control	65	99	1.51
Railroad ballast	43	131	3.01
Other[3]	2,770	6,597	2.38
Total or average	7,776	[3]21,269	2.74

W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]Includes road and other stabilization (cement and lime).
[2]Includes other unspecified uses and uses indicated by symbol W.
[3]Data do not add to total shown because of independent rounding.

Industrial.—Industrial sand and gravel was produced only in Park County.

Stone.—Stone production is surveyed by the U.S. Bureau of Mines for odd-numbered years only; therefore, this chapter contains only estimates for 1984. Data for even-numbered years are based on annual company estimates made before yearend.

Travertine building stone was produced by Livingston Marble & Granite Works from quarries near Gardiner in Park County and marketed from its plant at Livingston.

Sulfur (Recovered).—Montana Sulphur & Chemical Co. and Farmers Union Central Exchange recovered sulfur as a byproduct from petroleum refining in Yellowstone County. The amount of sulfur produced declined 15% and the value was down 12% from that reported in 1983.

Talc.—Montana ranked second in the Nation in 1984 for the quantity, and gained first ranking in the value of talc production for the year. The 1984 production increased 32% in quantity and 28% in value over that of 1983. All of the State's talc was open pit mined from deposits in the Ruby and Gravelly Ranges in Madison County. Cyprus Industrial Minerals Co. reactivated and expanded production at its Beaverhead Mine and stepped up production at its Yellowstone Mine; the ore was processed at its Three Forks mill. Pfizer Inc. operated its Treasure Chest Mine and Barretts mill south of Dillon. Uses for talc produced in Montana were in paint (29%), paper (18%), ceramics (10%), plastics (5%), cosmetics (4%), and other uses including rubber, roofing, refractories, and miscellaneous.

NICOR Mineral Ventures completed a final feasibility study on its Montana Talc project. The company plans to invest $10 million in a new open pit talc mine near Ennis and a mill on rail at Sappington. The mine, adjacent to Cyprus' Yellowstone Mine, has an identified 1-million-short-ton reserve; estimated mine life is 13 years. Exploration activity for talc increased in the Precambrian areas of southwestern Montana in 1984.

Vermiculite.—Montana again led the Nation in the production of vermiculite. Production in 1984 was about 92% of the yearly average for the 5-year period (1980-84); the value of production was 8% more than the yearly average for the 5-year period. W. R. Grace & Co. continued to mine and mill vermiculite at its Rainy Creek operation north of Libby in Lincoln County. Robinson Insulation Co. at Great Falls, Cascade County, produced exfoliated vermiculite, which was sold for building aggregates, insulation, and agricultural applications.

[1]State Mineral Officer, Bureau of Mines, Spokane, WA.
[2]Acting director, Montana Bureau of Mines and Geology, Butte, MT.
[3]Staff field agent, Montana Bureau of Mines and Geology, Butte, MT.

Table 7.—Principal producers

Commodity and company	Address	Type of activity	County
Aluminum:			
ARCO Aluminum Co., a division of Atlantic Richfield Co.	Columbia Falls, MT 59912	Reduction plant	Flathead.
Barite:			
Montana Barite Co. Inc., a subsidiary of NICOR Mineral Ventures.	6700 Desmet Rd. Box 3296 Missoula, MT 59806	Mine and plant	Lincoln and Missoula.
Cement:			
Idea! Basic Industries Inc., Cement Div.[1]	Box 8789 Denver, CO 80201	Plant	Gallatin.
Kaiser Cement Corp.[1]	300 Lakeside Dr. Oakland, CA 94612	do	Jefferson.
Clays:			
American Colloid Co	5100 Suffield Ct. Skokie, IL 60078	Pits and plant	Carbon and Phillips.
Federal Bentonite Div., Aurora Industries Inc.	609 Fifth Ave. Belle Fourche, SD 57717	Pit and plant	Valley.
International Minerals & Chemical Corp., Industrial Minerals Div.	Box 460 Belle Fourche, SD 57717	Pits	Carter.
NL Industries Inc., Baroid Div	Box 1675 Houston, TX 77251	Pit and plant	Do.
Copper:			
ASARCO Incorporated	Box 868 Troy, MT 59935	Underground mine and plant.	Lincoln.
Gold:			
Golden Sunlight Mines Inc., a subsidiary of Placer U.S. Inc.[2]	Box 678 Whitehall, MT 59759	Open pit mine and plant	Jefferson.
Pegasus Gold Inc.[2]	Zortman, MT 59546	do	Phillips.
Gypsum:			
Maronick Construction Co. Inc.[3]	East Helena, MT 59635	Open pit mine	Judith Basin.
United States Gypsum Co	Heath, MT 59457	Underground mine and plant.	Fergus.
Lime:			
Continental Lime Inc	268 West 400 South Suite 201 Salt Lake City, UT 84101	Open pit mine	Broadwater.
The Great Western Sugar Co	1530 16th St. Denver, CO 80217	Surface mine and plant	Yellowstone.
Holly Sugar Corp	Box 1052 Colorado Springs, CO 80901	do	Richland.
Phosphate rock:			
Cominco American Incorporated	Box 638 Garrison, MT 59731	Underground mine	Powell.
Sand and gravel:			
Jim Gilman Excavating Inc	3105 Kossuth Butte, MT 59701	Pits	Silver Bow.
Konitz Contracting Inc	Box 595 Lewistown, MT 59547	Pit	Fergus.
Barry O'Leary Inc	1041 North Fourth Ave. Billings, MT 59103	Pit	Yellowstone.
Shellenger Construction Co	Box 517 Columbia Falls, MT 59912	Pits	Flathead.
United Industries, Midland Materials Co.	Box 30238 Billings, MT 59107	do	Cascade and Yellowstone.
Washington Construction Co	Box 8989 Missoula, MT 59807	Pit	Missoula.
Yellowstone County Highway Department.	Box 35023 Billings, MT 59107	Pits	Yellowstone.
Silver:			
ASARCO Incorporated[4]	Box 868 Troy, MT 59935	Underground mine and plant.	Lincoln.
Black Pine Mining Co.[4]	Box 610 Philipsburg, MT 59858	Underground mine	Granite.
Stone (dimension):			
Livingston Marble & Granite Works	Box 851 Livingston, MT 59047	Quarries and plant	Park.
Sulfur (recovered):			
Montana Sulphur & Chemical Co	Box 31118 Billings, MT 59107	Plant	Yellowstone.
Talc:			
Cyprus Industrial Minerals Co., a subsidiary of Amoco Minerals Co.	Box 3299 7000 South Yosemite Englewood, CO 80155	Plant and open pit mines	Gallatin and Madison.
Pfizer Inc	Box 1147 Dillon, MT 59725	Plant and open pit mine	Beaverhead and Madison.
Vermiculite:			
W. R. Grace & Co., Zonolite Div	1114 Avenue of the Americas New York, NY 10036	do	Lincoln.

[1]Also clays and stone.
[2]Also silver.
[3]Also stone.
[4]Also copper, gold, and lead.

☆U.S. GOVERNMENT PRINTING OFFICE: 1986-491-457:20116